

Patent Claims

1. A light source (2) having at least one light module (13) and one drive module (12) with drive electronics (15),
5 characterized in that the light module (13) and the drive module (12) each have their own mount element (14, 22), the light module (13) has a first mount element (22) and the drive module (12) has a second mount element (14), and are connected, attached to one another, to a common mount (11),
10 with the light module (13) being connected to the drive module (12) by means of electrical first lines (21), which are designed in such a manner that thermally caused relative movements between the drive module (12) and the light module (13) are absorbed without destruction, by deformation of the
15 first lines (21).

2. The light source (2) as claimed in claim 1, characterized in that the electrical first lines (21) for connection of the light module (13) to the drive module (12)
20 are in the form of bonding wires.

3. The light source (2) as claimed in claim 1, characterized in that the light module (13) has at least one semiconductor chip (52, 53, 54, 55), which is arranged on a
25 conductor layer (51), such that it is electrically conductively connected to the conductor layer (51).

4. The light source (2) as claimed in claim 1, characterized in that the semiconductor chip (52, 53, 54,
30 55) has a power consumption of at least 0.5 watts.

5. The light source (2) as claimed in claim 3, characterized in that the conductor layer (51) is applied to a third mount element (50) composed of ceramic.

5 6. The light source (2) as claimed in claim 5, characterized in that the ceramic is a thermally conductive hybrid.

7. The light source (2) as claimed in claim 6,
10 characterized in that the ceramic is an aluminum-oxide ceramic.

8. The light source (2) as claimed in claim 5, characterized in that the ceramic has a coefficient of
15 thermal conductivity of at least 5 K/W, and is an electrical insulator.

9. The light source (2) as claimed in claim 5, characterized in that the third mount element (50) is
20 attached to the first mount element (22).

10. The light source (2) as claimed in claim 1, characterized in that the conductor layer (51) is composed at least partially of a mixture comprising silver and
25 platinum.

11. The light source (2) as claimed in claim 1, characterized in that the conductor layer (51) has conductor tracks (57) which are connected to that face of the
30 semiconductor chip (52, 53, 54, 55) which points away from the conductor layer (51) by means of at least one second

electrical line (25), which is in the form of a bonding wire.

12. The light source (2) as claimed in claim 9,
5 characterized in that conductor tracks (57) on the conductor layer (51) are connected by means of third electrical lines (27) to the junction between the third mount element (50) and lines (25) which are electrically conductively connected to the drive module (12) and the third lines (27) are in the
10 form of bonding wires.

13. The light source (2) as claimed in claim 1, characterized in that the light module (13) has a plurality of semiconductor chips (52, 53, 54, 55), and the conductor
15 layer (51) as well as the connection are designed in such a manner that at least two semiconductor chips (52, 53, 54, 55) can have an electrical voltage applied to them, independently of one another, by means of the conductor tracks (57).

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14. The light source (2) as claimed in claim 1, characterized in that the light module (13) has two semiconductor chips (52, 53), in which case red-colored light can be emitted by means of a first semiconductor chip
25 (52), and green-colored light can be emitted by means of a second semiconductor chip (53).

15. The light source (2) as claimed in claim 1, characterized in that the light module (13) has four
30 semiconductor chips (52, 53, 54, 55), in which case red-colored light can be emitted by means of a first and a second semiconductor chip (52, 53), and green-colored light can be emitted by means of a third and a

fourth semi-conductor chip (54, 55).

16. The light source (2) as claimed in claim 1,
characterized in that the light module (13) has three
5 semiconductor chips (52, 53, 54), in which case red-colored
light can be emitted by means of at least one semiconductor
chip, and green-colored light can be emitted by means of at
least one further semiconductor chip.

10 17. The light source (2) as claimed in claim 1,
characterized in that the light module (13) has four
semiconductor chips (52, 53, 54, 55), in which case green-
colored light can be emitted by means of a first and a
second semiconductor chip (52, 53), red-colored light can be
15 emitted by means of a third semiconductor chip (54) and
blue-colored light can be emitted by means of a fourth
semiconductor chip (55).

18. The light source (2) as claimed in claim 1,
20 characterized in that the light module (13) has a first
printed circuit board, on which the third mount element (50)
is mounted.

19. The light source (2) as claimed in claim 18,
25 characterized in that the first mount element (22) is in the
form of a printed circuit board and has one flat face which
rests on the mount (11).

20. The light source (2) as claimed in claim 1,
30 characterized in that the mount (11) is in the form of a
heat sink.

21. The light source (2) as claimed in claim 1, characterized in that the mount (11) is composed of aluminum.

5 22. The light source (2) as claimed in claim 1, characterized in that the second mount element (14) is in the form of a printed circuit board, which has one flat face which rests on the mount (11).

10 23. The light source (2) as claimed in claim 1, characterized in that the light module (13) and/or the drive module (12) are/is attached to the mount (11) by means of adhesive.

15 24. The light source (2) as claimed in claim 1, characterized in that a drive module (12) is associated with a plurality of light modules (13).

20 25. The light source (2) as claimed in claim 1, characterized in that a temperature sensor (60, 61) is arranged on the drive module (12) and/or on the light module (13).

25 26. An image-production unit (1) for a head-up display having a light source (2) as claimed in at least one of the preceding claims.

30 27. The image-production unit (1) as claimed in claim 26, characterized in that secondary optics (3) are arranged downstream in the beam path (5) which originates from the light source (2).

28. The image-production unit (1) as claimed in claim 26 or 27, characterized in that the secondary optics (3) comprise a reflector.

5 29. The image-production unit (1) as claimed in one of the preceding claims 26 to 28, characterized in that the reflector is designed to be totally reflective.

10 30. The image-production unit (1) as claimed in at least claim 29, characterized in that the reflector is composed of a transmissive polymer.

15 31. The image-production unit (1) as claimed in at least claim 29 or 30, characterized in that the reflector has an external contour essentially in the form of a cone or pyramid.

20 32. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 31, characterized in that the reflector has an input side (30) on which light from at least one light source (2) enters, and an output side (31), on which input light emerges.

25 33. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 32, characterized in that the reflector emits a widening light beam which has a boundary surface, which boundary surface forms an angle of about 5° - 15° with a central axis which runs centrally through the light beam in the main light propagation
30 direction (6).

34. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 33, characterized in that the external contour of the reflector is convex.

5 35. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 34, characterized in that the external contour of the reflector is in the form of a rotational paraboloid which widens in the main light propagation direction (6), and the rotational paraboloid is
10 based on a fifth-order polynomial.

36. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 35, characterized in that the reflector has a recess, which is provided on the light
15 module (13) and at least partially holds light means (24)', on the input side.

37. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 36, characterized in that
20 the recess has a cylindrical side boundary contour, which extends parallel to the central axis.

38. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 37, characterized in that
25 the recess has an end surface which is arranged opposite the light source (2) in the direction of the central axis and has convex curvature in the direction of the light source (2).

39. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 38, characterized in that the reflector has an outlet area with a diagonal size of about 20 mm.

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40. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 39, characterized in that the recess has a diagonal size of about 5 mm.

10 41. The image-production unit (1) as claimed in at least one of the preceding claims 26 to 40, characterized in that a plurality of reflectors which are associated with light modules (13) are arranged adjacent to one another.

15 42. The image-production unit (1) as claimed in claim 41, characterized in that a common light-mixing module (3) is arranged downstream from the reflectors in the beam path (5).

20 43. The image-production unit (1) as claimed in claim 42, characterized in that a translucent display (9) is arranged downstream from the light-mixing module (3).

25 44. The image-production unit (1) as claimed in claim 42 or 43, characterized in that the light-mixing module (3) is in the form of a box with a light inlet side (40) and a light outlet side (41), and has side walls (42) which reflect inward.

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45. The image-production unit (1) as claimed in at least one of claims 43 or 44, characterized in that at least one mirror (7) is arranged in the beam path (5) between the light module and the display, and folds the beam path (5).

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46. The image-production unit (1) as claimed in at least one of claims 43 to 45, characterized in that a scattering disk (8) is arranged in the beam path (5) between the light module (13) and the display (9).